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SKENIDIOIDES AND *LEPTAENISCA* IN THE LOWER DEVONIAN OF AUSTRALIA (VICTORIA, TASMANIA) AND NEW ZEALAND, WITH NOTES ON OTHER DEVONIAN OCCURRENCES OF *SKENIDIOIDES*

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Abstract

Skenidioides and *Leptaenisca* are illustrated for the first time from the region of southeastern Australia and New Zealand and are present in beds of Early Devonian age. *Skenidioides* is typically an Ordovician and Silurian brachiopod, but a review of its occurrences on a world-wide basis indicates that it is widely represented in Lower Devonian and Middle Devonian rocks in the Old World (meaning Europe, Asia, and North Africa) and in western North America, but not in the Appalachian Province where it is replaced by the endemic genus *Skenidium*.

Introduction

The writers have had a keen interest in the distribution of braehiopod genera on a world-wide basis during Early Devonian time. These studies show that *Skenidioides*, a typieal orthoid genus of the Ordovieian and the Silurian, ranges well up into the Lower Devonian and even into the Middle Devonian of the Old World. A review of the Devonian oeeurrenees shows that the genus *Skenidium*, often eited as inelusive of the Devonian speeies, is instead restrieted to oeeurrenees in the Lower to Upper Devonian of the Appalaehian Provinee. In the Old World its eeologie niehe is apparently filled by the long-lived *Skenidioides* whieh persisted at least until Givetian time. Therefore, it is of eonsiderable interest to find *Skenidioides* in the Lower Devonian of Vietoria and Tasmania and its presence there adds to the known list of genera that have affinities with Old World faunas.

The distribution of *Leptaenisca* is less well known, but it is established in the Silurian and Lower Devonian in the Appalaehian Provinee and it is also present in the earliest Lower Devonian in Nevada. The presenee of *Leptaenisca* in the Baton Formation of New Zealand (ef. Boueot et al. 1963, p. 85; illustrated herein) and in the Lower Devonian of Loyola, Vietoria extends the known geographie range of the genus.

Occurrence of *Skenidium*

As the writers began working on the present paper and reviewed the youngest reported oeeurrenees of *Skenidium* and *Skenidioides*, it was diseovered that at least some of the Devonian oeeurrenees beyond North Ameriea, previously attributed to *Skenidium*, instead were of shells that properly belong to *Skenidioides*. With this in mind the review of all the Devonian oeeurrenees known to the writers revealed a systematie pattern to the geographie distribution of the two genera in roeks of Late Gedinnian (New Scotland) to Givetian age, and as the summary

below indicates, we find that all of the Lower and Middle Devonian *'Skenidium'* occurrences beyond the Appalachian Province either can certainly be assigned to *Skenidioides* or are unknown internally. *Skenidium*, therefore, is not known outside the Appalachian Province until the Frasnian when it is present in Western Australia (Veevers 1959, Pl. 1).

Genus **Skenidioides** Schuchert & Cooper 1931

TYPE SPECIES: *S. billingsi* Schuchert & Cooper 1931; 1932, p. 72, Pl. 10, fig. 6, 8, 10-14.

Devonian occurrences of *Skenidioides*

Skenidium lewisi Kozlowski 1929 (p. 47, Pl. 1, fig. 20-21, *not* Davidson) from the Borszczów stage (Early Gedinnian) of Podolia. Kozlowski's Fig. 5 (p. 48) shows that the Borszczów form has the cardinalia of *Skenidioides* rather than *Skenidium*.

Skenidium polonicum Gürich, from the Givetian of the Holy Cross Mountains (Biernat 1959, p. 16). Biernat's illustration of the dorsal interior (1959, Pl. 1, fig. 8) is of a specimen with the cardinalia of *Skenidioides* rather than *Skenidium*.

Skenidioides spp., from the Bell Shale of Tasmania and from Thompson's Ridge, Puckapunyal, Victoria (illustrated herein).

Skenidioides sp., in beds of Gedinnian age, upper Roberts Mountains Formation, northern Roberts Mountains, central Nevada (Johnson in preparation).

Skenidioides sp., in beds of Early Devonian age in the Lynn Window, northern Nevada (Johnson in preparation).

Skenidioides sp., from the upper part of the Road River Formation of Royal Ck, Yukon, Canada, 1½ and 2 miles W. of the holotype locality of *Monograptus yukonsis* Jackson and Lenz (1963). The brachiopods are underlain and overlain by *Monograptus yukonensis* which elsewhere in the Yukon is associated with *Monograptus* cf. *praehercynicus*. The graptolites therefore strongly indicate an early Devonian age for the Yukon occurrence.

Skenidioides occurs with a rich, silicified brachiopod fauna including *Aesopomum* sp., *Ambocoelia* cf. *praecox* Kozlowski, *Anastrophia* cf. *magnifica* Koz., *Atrypa* spp. including *A.* cf. *oklahomaensis* Amsden, aff. *'Atrypa' audux* Barr., ? *Biconostrophia*, *'Cymostrophia'* cf. *costatula* (Barr.), *Cyrtina*, *Desquamatia*, *'Nadiastrophia'*, dolerorthid gen. nov. cf. *Dolerorthis* and *Ptychopleurella*, *Gypidula* spp., *Schizophoria*, *Kayserella* sp., *Plicocyrtina* sp., *Latonotoechia*? sp. or *Machaeraria*? sp., *Nucleospira* cf. *ventricosa* (Hall), orthotetaceid gen. indet., *Plicoplasia*, *Protathyris* cf. *praecursor* Koz., *'Isorthis'* aff. *fornicatimcurvata*, aff. *'Phragmophora' punctata* Talent, septate dalmanellid gen. nov., and *Spinatrypa* sp. New and larger brachiopod collections show that the specimen identified as 'triplesiid gen. indet.' (Jackson & Lenz 1963, p. 752) is the orthotetacean genus *Aesopomum*. In addition, *'Nadiastrophia'*, *Plicocyrtina*, *Keyserella*, *Plicoplasia*, and two septate dalmanellids are newly reported. *Keyserella* has heretofore been known only from the Middle Devonian, but *Plicoplasia*, *'Nadiastrophia'*, and the new genus of septate dalmanellid indicate a post-*Quadrithyris* zone, i.e. post-earliest Siegenian age (Johnson 1965). The presence of the new septate dalmanellid requires an assignment below the *pinyonensis* zone of Nevada while the presence of *Anastrophia* suggests a position immediately below the *Karpinskia conjugula* beds of the Uralian sequence.

Skenidioides sp. Kartal Schichten (Tiefe serie 4 of Erben 1960), Ankara Yolu 200 miles W. Brücke an der Abzweigüng nach Tuzla in Strasseneinschnitt,

Turkey. Boucot coll. 1960. USNM No. 10677. The collection has also yielded several pedicle valve internal moulds of *Leptaenisca*. Boucot was guided to the locality by Dr Winifried Haas.

Devonian species questionably assigned to *Skenidioides*

Skenidium moelleri and *Skenidium uralicum* Tschernychew 1887 (Pl. 4, fig. 13-17); these forms from the Devonian of the Ural Mountains are not certainly assignable to the Skenidiidae because the available illustrations are inadequate to show the internal structure.

Scenidium baylei (Rouault *in* Oehlert 1888, p. 60, Pl. 5, fig. 8-10. Figures show only exteriors.

Skenidium suburbanum Havlíček 1956 (p. 537, Pl. 7, fig. 5-10) from the Dvorce Limestones in the vicinity of Prague. The species is not certainly assignable because Havlíček's figures do not illustrate the dorsal interior.

Skenidium aff. *polonicum* Drot 1961 (p. 61, Pl. 1, fig. 6). Drot's specimen comes from the upper Givetian in beds with *Stringocephalus* from the Draa region of the Morocco Presahara. Drot's figures do not illustrate the interior of the brachial valve.

Skenidioides spp.

(Pl. 40, fig. 6-13)

MATERIAL: The specimens consist of internal moulds of free brachial and pedicle valves. There are two pedicle valve internal moulds from Victoria (Geol. Surv. Victoria No. 61318, 19). There are two brachial valve internal moulds and one pedicle valve internal mould from Tasmania, NMV P24252-54.

PEDICLE VALVE: The valve is semi-conical to sub-pyramidal in configuration with a moderately high palintrope. Cardinal angles are obtuse and rounded. Maximum width is found in the posterior half. The lateral margin is smoothly curved and the commissure is rectimarginate. The external ornament consists of numerous fine rounded costellae, poorly preserved on the available internal moulds. The interarea is triangular and generally a little lower than wide. The specimen with the highest interarea appears to have been compressed somewhat laterally.

Internally there is a deep, broad, rounded spondylium supported in the apex of the valve by a short pillar-like septum. The spondylium fills a little more than half of the otherwise open delthyrium.

BRACHIAL VALVE: Brachial valves are suboval in outline and the specimen appearing to be least deformed is decidedly more transverse than elongate. Cardinal angles are rounded and obtuse. Maximum width is in the posterior half and there is a shallow sulcus medially. There is a fairly well developed flat, anacline to gently curved triangular interarea.

Internally the sockets are shallow to cylindrical with their bases elevated free above the base of the valve. The proximal ends of the sockets may be covered by the anterior edge of the interarea. The brachiophores are attached to the inner edges of the hinge plates and are triangular in transverse section. The flat ventral faces are narrow and ribbon-like. Their bases are connected with curving plates that join the median septum above the floor of the valve to form a cruralium. A median septum extends from the notothyrial cavity to the anterior commissure of the valve, and the area of the cruralium has about half of its height above and half below the junction line. The interior is lightly crenulated by the costellae.

DISCUSSION: According to Schuchert and Cooper (1932, p. 73) '*Skenidioides* was separated from *Skenidium* chiefly because it does not possess the peculiar hinge-

plate characteristic of the dorsal valve of the latter'. The cardinalia of the specimens at hand are decidedly of the *Skenidioides* conformation. In addition to the diagnostic features of the cardinalia, the deep spondylium in the pedicle valve and the well developed dorsal interarea also are in agreement with an assignment to *Skenidioides* rather than *Skenidium*; so considering all the features there are none that make the *Skenidioides* assignment inconsistent.

OCCURRENCE: Bell Shale, in a small quarry on the N. bank of a creek tributary to the Little Henty R., NE. of Zeehan, Tasmania (locality 1 of Gill & Banks 1950); the precise horizon within this formation is uncertain owing to strong faulting in the vicinity. The association of *Plectodonta bipartita* (Chapman) and *'Chonetes' ruddockensis* Gill at this locality (Gill 1950) indicates correlation with the lower Ruddock Siltstone (Gill 1965) of the Lilydale district of Victoria. This is reinforced by the presence of *Proetus euryceps* (McCoy) which occurs with these forms at a comparable horizon in the Kinglake district of Victoria (Williams 1964). These horizons are thought to be Upper Gedinnian since the associated Bell Shale fauna indicates a close correlation with the Thompson's Ridge specimens.

Brachiopod band, Thompson's Ridge, Puckapunyal, Victoria, Heathcote 1 mile sheet grid reference 432·9, 296·8. This locality has yielded a fairly large but nondescript brachiopod fauna. Stratigraphic and palaeontologic evidence from the Seymour-Puckapunyal district as a whole (Schleiger & Talent unpub.) indicates that this horizon is within equivalents of the Mt Ida Formation at Heathcote, most probably correlating with unit 2 of that formation. This is presently accorded a probable late Gedinnian age (Talent 1965).

Genus **Leptaenisca** Beecher 1890

TYPE SPECIES: *Leptaena concava* Hall 1857, p. 47.

Leptaenisca spp.

(Pl. 40, fig. 1-5)

MATERIAL: We have before us three specimens and all are internal moulds. There are two pedicle valve internal moulds from the Baton Formation of New Zealand (NZGS No. 1386, 87) and a single brachial valve internal mould from the vicinity of Loyola in the Mansfield District of Victoria, Australia (NMV No. P12402).

PEDICLE VALVE: The outline is transversely shield-shaped with long straight hinge line and near rectangular cardinal angles. The valve is strongly convex and somewhat geniculate anteriorly, forming a straight anterior margin. The interarea is long, low, well developed, ribbon-like, and apsacline.

The hinge teeth are poorly defined but appear to be relatively blunt. They project dorsomedially and are free basally. The dental lamellae appear to grow from positions lateral to the teeth and their posterior tracks. The dental lamellae extend parallel to the midline about a third of the distance of the shell length and converge slightly medially to form a spondylium-like structure on the floor of the valve. Medially the structure is bisected by a low blade-like median septum that does not extend anteriorly beyond the edge of the spondylium-like structure. The visceral cavity is impressed and transversely suboval. The posterolateral extremities are differentiated as flat, triangular, platform-like areas. The internal surface of the valves is pustulose, probably corresponding to the positions of the pseudopunctae.

BRACHIAL VALVE: The outline is transversely subquadrate to shield-shaped with a long straight hinge line. The maximum width is situated slightly anterior to the

hinge line and the cardinal angles are rounded, though acute. In lateral profile the valve is moderately concave.

The cardinalia consists of a pair of cardinal process lobes cleft medially by a deep V-shaped groove that decreases in width slightly toward the anterior margin of the lobes. The sockets consist of deep incisions at the hinge line lateral to the cardinal process lobes which bound them medially. The sockets diverge anterolaterally, but only a small amount from the midline. The adductor muscle impressions consist of a small confined elongate suboval pair that are bounded posterolaterally by prominent muscle bounding ridges that buttress the cardinal process lobes laterally. The adductor muscle impressions are divided medially by a split myophragm that broadens slightly anteriorly, partially enclosing a shallow elongate central pit. Most of the remainder of the interior of the shell is impressed by the brachial ridges which curve strongly laterally from the anterolateral edges of the adductor scars then recurve around the inner margin of the valves, nearly meeting medially. The centres of their spirals are situated at about midlength. The whole interior of the valve is pustulose.

OCCURRENCE: The Victorian specimen of *Leptaenisca*, preserved as a mould in mudstone, was collected by Mr George Sweet towards the close of the last century from Loyola, near Mansfield; a precise location was not given. Four lenticular bodies of limestone occur at Loyola: on the N. boundary of allot. 94; SE. corner of allot. 94 (small quarry); allot. 132E (Griffiths' Quarry); W. boundary of allot. 133. These are not far apart stratigraphically, occurring along approximately the same strike for 1½ miles interbedded with WSW. dipping Lower Devonian shales, siltstones, sandstones, and minor grits. The coral-stromatoporoid faunas of the limestones (Ripper 1937, Hill 1939) and the brachiopod faunas of the underlying terrigenous sediments (essentially unpublished) indicate a fairly tight correlation with the limestones at Deep Ck, Walhalla and with the Cooper's Creek Formation and upper Tanjil Formation ('Boola Beds') of the Walhalla-Cooper's Ck and Tyers area (Talent 1965, Fig. 2). A broad Siegenian age is indicated, probably Upper Siegenian. There is no certainty as to provenance of the specimen at Loyola, but the late Mr W. Griffiths (pers. comm. J. A. Talent) has indicated that the bulk of the collections made by Mr Sweet at Loyola were the result of about one month's collecting with the aid of a hired labourer on the hillside in the present allotment 132C. E. to SE. of Griffiths' Quarry; it is most likely therefore that the specimen came from a horizon stratigraphically lower than the limestone lenses.

The New Zealand specimens were collected by Prof. A. H. Lillie and students from bluffs on the N. side of the Baton R. about 300 ft above the Baton River Track at a distance of approximately 400 yds upstream from a swing bridge over the river. The locality is upstream from Heine Stream within Member 3 of the Baton Formation at approximate grid reference S19/062273; it was most probably one of the five fossiliferous bands in the upper 900 ft of this member which provided the fossils described by Shirley (1938) (pers. comm. M. R. Gregory; ref. Willis 1965).

DISCUSSION: Even though the pedicle valves and the single brachial valve internal mould described and illustrated in this paper come from distant localities, the assignments appear firm to us. The pedicle valves from the Baton Formation have dental lamellae shaped differently than those in *Leptaenisca concava* illustrated by Amsden (1958, Pl. 5, fig. 15, 16) and because they are subparallel or even converge slightly anteriorly toward a low median ridge they are close to

specimens of *Leptaenisca* present in the *Quadrithyris* zone (probably early Siegenian) in central Nevada (Johnson 1965 and in prep.). In the brachial valve the specimen of *Leptaenisca* from Victoria (Pl. 40, fig. 1, 2) compares favourably with the brachial valves illustrated by Amsden (1958, Pl. 5, fig. 22, 24) and by Muir-Wood and Cooper (1960, Pl. 133, fig. 7-10). The American specimens differ principally in lacking well developed bounding ridges around the dorsal adductors that laterally buttress the cardinal process lobes. The split myophragm which joins the central pit posterolaterally is well developed on the Australian specimen, but is rather insignificant on the American ones. It appears that the differences in and around the site of adductor attachment are sufficient to make the Australian specimens a new species, but at present the available material is inadequate as a proper base on which to propose a new name.

Although the Australian and New Zealand specimens are confidently assigned, it is worth mentioning some forms once thought to be related. *Davidsonia*, as illustrated by Davidson (1864, 1865, Pl. 11, fig. 13-16) has very different cardinalia, more like an orthotetacean with strong inner socket ridges that connect posteromedially and thus are not at all comparable to the bilobed cardinal process of *Leptaenisca*. The same may be said for the genus *Leptaenoidea* (Hedström 1917, Pl. 1) although Williams classes it with *Leptaenisca*. Accordingly, Williams (1953, p. 4) classes *Davidsonia* as an orthotetacean and Havlíček (1956) places both of his new genera *Biconostrophia* and *Prodavidsonia* in the Orthotetacea also, although the writers would suggest the possibility that *Biconostrophia* is a carinatininid atrypid (see Havlíček 1956, Pl. 7, fig. 23, 24, 27) because of the form and type of ribbing.

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Explanation of Plate

PLATE 40

Fig. 1-2—*Leptaenisca* sp. Vicinity of Loyola, Mansfield District, Victoria, Australia. 1, 2—Rubber impression and internal mould of brachial valve × 8, NMV No. P12402.

Fig. 3-5—*Leptaenisca* sp. Baton Formation, N. bank of Baton R., bluffs, 300 ft above track, between 500 ft and 2,000 ft upstream of mouth of Heine Stream and apprx. 400 yds upstream of a swing bridge that crosses Baton R. approx. grid ref. S19/062273. Collected by A. R. Lillie, 1960. USNM loc. 11979. 3, 4—Internal mould and rubber impression of pedicle valve × 8, NZGS No. BR 1386. 5—Internal mould of pedicle valve × 8, NZGS No. BR 1387.

Fig. 6-10—*Skenidioides* sp. Bell Shale, locality 1 of Gill & Banks (1950), Tasmania, Australia. 6, 8—Rubber impression × 10 and internal mould of brachial valve × 5, NMV P24252. 7, 9—Internal mould of brachial valve × 5, and rubber impression × 10, NMV P24253. 10—Posterior view of pedicle valve of internal mould × 5, NMV P24254.

Fig. 11-13—*Skenidioides* sp. Thompson's Ridge, Puckapunyal, Victoria, Australia. Collected by N. W. Schleiger. 11, 12—Posteroventral and ventral views of internal mould of pedicle valve × 5, Geol. Surv. Vict. 61318. 13—Ventral view of internal mould of pedicle valve × 5, Geol. Surv. Vict. 61317.